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Key Factors of Effective Development of Smart Cities in Croatia

Abstract

World trends are showing a continuous increase in the number of inhabitants living in cities. It is expected that 70% of total world and 80% of total European population will live in cities by 2050. By increasing the number of inhabitants, the challenges of city management are growing as well. With the aim of achieving maximum living standards and quality of life of their inhabitants, the implementation of smart city model proves to be a necessity. The Republic of Croatia, as a member of the European Union, is obliged to follow recommendations contained in a series of documents and conclusions, as well as use the sources of funding available to European member states. The paper provides a framework for understanding the concept of smart cities through an overview of scientific literature, examples of good practice from Europe and the world, and a detailed analysis of the state and degree of development of smart cities in the Republic of Croatia, focusing on key dimensions of smart city development. It has been proven that investing in key dimensions of a smart city: Population, technology, and institutions, generates revenue growth, economic development, and better living quality of city population. The research methodology for this paper is based on a mixed method that involves collection, analysis, and integration of quantitative and qualitative research.

The aim of the paper is to provide a framework for understanding the concept of a smart city, point out the advantages of such management mode, as well as the key dimensions to be invested in, in order to boost economic development and quality of life of the dominant, city population.

Keywords: smart cities, dimensions of the development of smart cities, smart cities in Croatia

1. Introduction

World trends are showing a continuous increase in the number of inhabitants living in cities. It is expected that 70% of the total world and 80% of the total European population will live in cities by 2050. Owing to the increase of the number of inhabitants, the challenges of city management are growing as well. With the aim of achieving maximum living standards and quality of life of their inhabitants, the implementation of a smart city model proves to be a necessity. It is expected that, by 2050, 80% of the total carbon dioxide emissions will originate from urban areas. The Republic of Croatia, as a member of the European Union, is obliged to follow recommendations contained in a series of documents and conclusions, as well as use sources of funding available to the European member states. Several policies and initiatives in place on the European Union level are promoting the development of smart cities:

- ◇ “The Energy Union Policy” sets targets and actions to transform the European energy system into the most sustainable one in the world.
- ◇ “The European Innovation Partnership on Smart Cities and Communities - (EIP-SCC)” is an initiative supported by the European Commission that brings together cities, industry, small business (SMEs), banks, research, and other.
- ◇ “The Urban Agenda for the EU” promotes better laws, easier access to funding, and more knowledge sharing on issues relevant for cities.
- ◇ “The Smart Cities Policy Context” aims to support the energy union and the Urban Agenda.
- ◇ “The Energy Performance of Buildings Directive - (EPBD)” promotes smart technologies in buildings to increase their energy efficiency.
- ◇ “The EU Covenant of Mayors for Climate & Energy” brings together thousands of local governments voluntarily committed to implementing EU climate and energy objectives in cities.
- ◇ “The Strategic Energy Technology Plane - (SET-Plan)” promotes research and innovation efforts across Europe by supporting the most impactful technologies in the EU’s transformation to a low-carbon energy system.
- ◇ “The Smart Cities Information System - (SCIS)”, which provides a lasting repository of information on smart city projects and serves as a knowledge platform to exchange data, experience and knowledge (European Commission, 2019).

The European Commission defines smart city as a place where traditional networks and services will be made more efficient by using digital and telecommunication technologies for the benefit of its inhabitants and businesses. They include not only the use of information and communication technologies for better resource use and less emissions, but also smarter urban transport networks, upgraded water supply and waste disposal facilities. They also include efficient ways to light and heat buildings, a

more interactive and responsive city administration, safer public spaces, and meeting the needs of an ageing population (European Commission, 2019).

The paper provides a framework for understanding the concept of smart cities through an overview of scientific literature, examples of good practice from Europe and the world, and a detailed analysis of the state and degree of development of smart cities in the Republic of Croatia, with a focus on key dimensions of smart city development. For the purpose of this analysis, the following hypothesis has been set:

Investing in key dimensions of a smart city: Population, technology, and institutions, generates revenue growth, economic development, and better quality of life of city population.

The research methodology for this paper is based on a mixed method that involves collection, analysis, and integration of quantitative and qualitative research. The aim of the paper is to provide a framework for understanding the concept of a smart city, point out the advantages of such management mode, as well as the key dimensions to invest in, in order to boost economic development and quality of life of the dominant, city population.

2. Defining the Smart City

The term „smart city“ was first used by The California Institute for Smart Communities in the 1990s, related to the use of information and communication technology with regard to modern infrastructures within cities (Alawadhi et al., 2012). The concept has been developing during the last thirty years, but there is not a one-size-fits-all definition of it (O’Grady & O’Hare, 2012). In order to provide theoretical contribution, there are several definitions of smart cities to be found in the available literature. According to Komninos (2011), smart cities are territories with high capacity for learning and innovation, which is the built-in creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management. The same author (Komninos, 2011) indicates that there are four dimensions that characterise smart cities:

Table 1: The Four Dimensions of Smart Cities

DIMENSION	CHARACTERISTICS OF DIMENSION
1	Application of a wide range of electronic and digital technologies to create a cyber, digital, wired, informational or knowledge-based city
2	The use of information technology to transform life and work
3	The implementation of information and communication technology in the city infrastructure
4	Connecting the information and communication technology and people together to enhance innovation, learning, and know-how

Source: Komninos (2011)

A definition that is focused on the information flow was given by other authors (Anavitarte and Tratz-Ryan, 2010), who stated that the smart city is based on intelligent exchanges of information that flow between its many different subsystems. Information are analysed and translated into citizen and commercial services within the smart governance-operating framework designed to make cities sustainable. Further, Hall (2000) considers a smart city as the city that monitors and integrates the conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, and even major buildings. It is the city that can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects, while maximizing services to its citizens.

A Smart City consists not only of components, but also of people. The European Union focuses on the following: "Securing the participation of citizens and relevant stakeholders in the Smart City is therefore another success factor. There is a difference if the participation follows a top down or a bottom-up approach. A top-down approach promotes a high degree of coordination, whereas a bottom-up approach allows more opportunity for people to participate directly". (Manville et al., 2017).

As stated before, there are many definitions of smart cities, while main elements are focusing on two categories: Input (activities) and outputs to implement in a smart city, and objectives to reach by implementing smart city solutions.

3. Key Dimensions Required for Effective Development of Smart Cities

In literature exploring smart cities, crucial dimensions are numerous. Three dimensions that stand out are: Technology, people, and community. When referring to the technology dimension, there are different terms used: Wired city, information city, ubiquitous city, digital city, and intelligent city. An older term “wired cities“, according to Dutton et al. (1987), characterized them as new sociotechnical systems, representing complex and interdependent social and technological arrangements. However, Hollands (2008) argued that wired city is not necessarily smart, but only means that it contains cable and connectivity. Hollands (2008) warns of the possibility that the smart city label can ideologically mask the nature of the underlying changes in cities, and it can represent an obstruction toward progressive urban change (Hollands, 2008). The term “information cities” refers to the following: “Digital environments collecting official and unofficial information from local communities and delivering it to the public via web portals are called information cities” (Anthopoulos & Fitsilis, 2010). The term “ubiquitous city“, represents an extension of digital city concept and refers to a city or region with ubiquitous information technology (Anthopoulos & Fitsilis, 2010). Digital city has a social, cultural, political, ideological, and theoretical dimension, and it is, as a comprehensive, web-based representation, or reproduction of several aspects or functions of a specific real city, open to non-experts (Couclelis, 2004). According to Komninos (2011): “Intelligent cities are territories with high capability for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management”. There is a fundamental difference between intelligent and digital city. Intelligent city puts an emphasis on the crossing of human and social capital, as the most valuable assets with digital city characteristic (Moser, 2001) that involves every function of the city such as work, housing, movement, recreation, and environment (Komninos & Sefertzi, 2009). So, while intelligent city characterizes a city that has the ability to support learning, technological development, and innovation procedures, it can be concluded that every digital city is not necessarily intelligent, but every intelligent city has digital components (Komninos & Sefertzi, 2009). Some authors (Odendaal, 2003) have a different view of the benefits of using information and communication technology, stating that their impact is still unclear since it can increase inequalities and promote digital division. The following possible challenges of using technologies were outlined (Ebrahim & Irani, 2005): IT training programs, lack of employees with integration skills and culture, lack of cross-sectorial cooperation, lack of inter-departmental coordination, unclear vision of IT management, politics and culture issues.

The dimension of “people” refers to creativity, education, learning, and knowledge as key drivers that have central importance to smart city vision (Nam & Pardo, 2011). Creative occupations and workforce, knowledge networks, voluntary organizations, crime-free environments, after-dark entertainment economy are creative elements of smart city development (Florida, 2003).

Smart city should be a centre of higher education (Winters, 2011) and consequently it should have large numbers of skilled workforce (Alfred & Glaeser, 2005). Learning city is the factor that improves the competitiveness of a city (Plumb et al., 2007) and is actively involved in building a skilled information economy workforce (Moser, 2001). Very similar to the term “learning city” is a “knowledge city” that implies “a city that was purposefully designed to encourage the nurturing of knowledge” (Edvinsson, 2006) and is related to knowledge economy (IBM, 2010).

According to relevant literature, the institutional dimension refers to the term of “smart community”. Smart community can be defined as a community broadly ranging from a small neighbourhood to a nation-wide community of common or shared interests, whose members, organizations, and governing institutions are working in partnership to use IT to transform their circumstances in significant ways (Canada, 1998). The key role in a smart community belongs to the governance (Chourabi et al., 2012), especially electronic governance (Paskaleva, 2009), since there are huge amounts of data obtained from informational and communication infrastructure that need to be analysed and used for the smart city benefits. However, some authors warned of the possibility of misusing these data and, in the worst-case scenario, the emergence of technocratic governance (Kitchin, 2014). Related to this issue, Hoque (2012) suggests algorithm-processed governance, as a protection against ethical claims of unclear decisions.

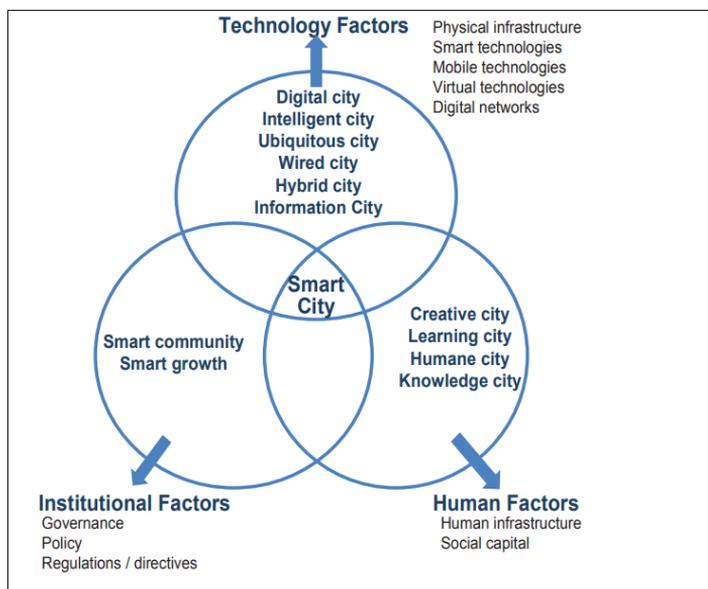


Figure 1: Main Components of Smart Cities
Source: Nam & Pardo (2011)

Based on a previous analysis of literature, the key components of smart cities can be simplified into three main factors (Figure 1): Technology that includes infrastructures of hardware and software, human factor that comprises creativity, diversity, and education, and institution included in governance and policy. The smart city is placed at the intersection of investments into human and social capital, where IT infrastructure supports sustainable growth and improves quality of life through participatory governance (Caragliu, Del Bo, & Nijkamp, 2009). Finally, it is necessary that a smart community consciously decides on use of the technology as means of development and satisfaction of its social and business needs (Eger, 2009) by smart institutional preparation and community governance. Johnston and Hanssen (2011) think that smart governance depends on the implementation of a smart governance infrastructure that should be accountable, responsive, and transparent (Mooij, 2003).

4. Smart City Concept in Croatia

The Republic of Croatia, as a member of the European Union, is obliged to follow recommendations contained in a series of documents and conclusions, as well as sources of funding available to the European member states.

Figure 2 shows the 'technology roadmap', with the focus on buildings, heating and cooling, electricity and transport - technologies that aim to improve the environment and therefore does not include all aspects of the Europe 2020 targets.

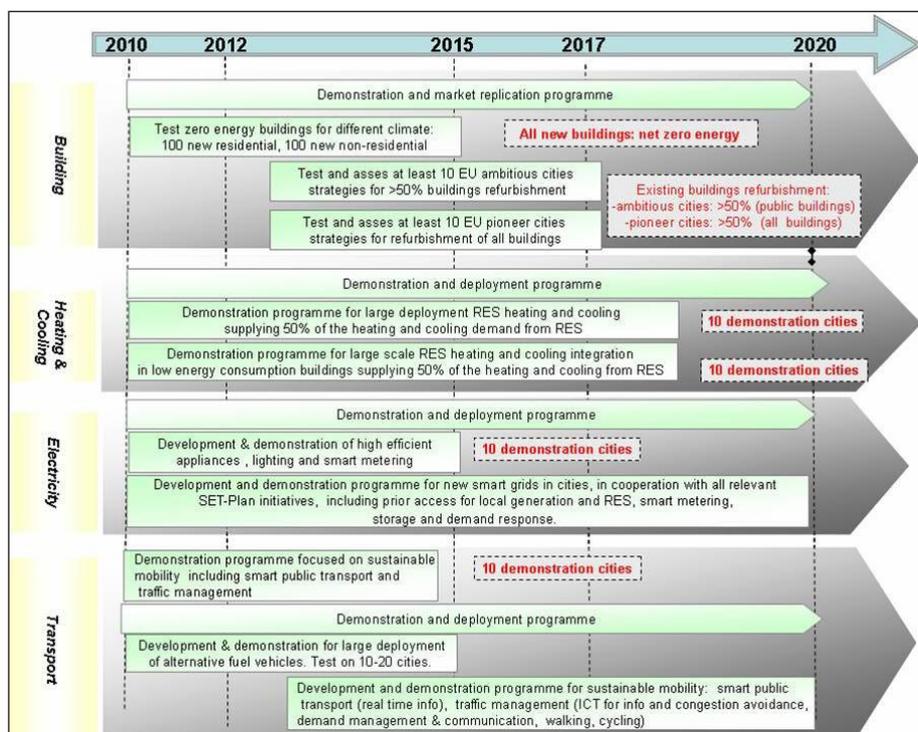
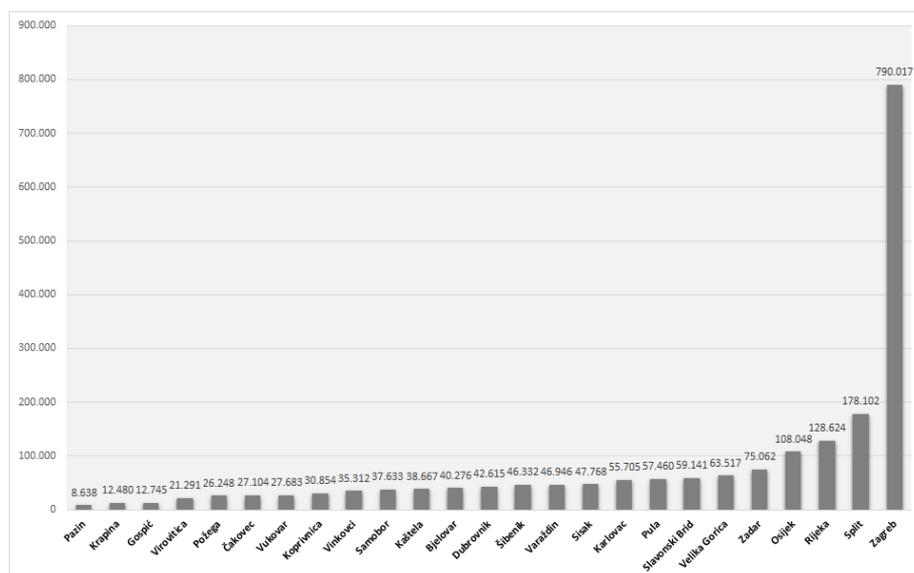


Figure 2: European Initiative on the Smart Cities Technology Roadmap
 Source: Setis-EU (2012)

As can be seen in Figure 2, European initiative on the Smart Cities will support cities and regions in taking measures to progress towards a 40% reduction of greenhouse gas emissions, through sustainable use and production of energy by 2020. Systemic approaches and organisational innovation, encompassing energy efficiency, low carbon technologies and the smart management of supply and demand are required, with - in particular - measures on buildings, local energy networks and transport, as the main components of the Initiative (Setis-EU, 2012).

There are 128 cities in Croatia and the latest data show that 59% of the Croatian population lives in urban areas. It is expected that 62.6% of the population will be living in cities by 2025 (Croatian Bureau of Statistics, 2017). The following graph shows the number of people living in cities that are county centres in Croatia (Graph 1).



Graph 1: Number of People Living in Large Cities, County Centres - Croatia
Source: authors, based on Croatian Bureau of Statistics (2017)

The research covering smart city situation in Croatia is not very extensive. Scientists from The Institute of Economics Zagreb (Jurlina Alibegović, Kordej-De Villa, & Šagovac, 2018) have performed the most recent one. It is based on the methodology developed under the European Smart Cities project (Giffinger et al., 2007). According to this methodology (Giffinger et al., 2007), there are six dimensions of the smart city concept:

1. Smart economy
2. Smart people
3. Smart governance
4. Smart mobility
5. Smart environment
6. Smart living

Smart economy refers to innovation, entrepreneurship, trademarks, productivity and flexibility of the labour market and integration in the national and international market, while the smart people dimension includes the level of education of citizens, the quality of social interactions regarding integration and public life and openness towards the world. Smart governance consists of political participation, services for citizens and functioning of city administration. Smart mobility involves local and international accessibility, availability of information and communication technologies, modern and sustainable transport systems. Smart environment encompasses natural conditions such

as climate, green spaces, pollution, resource management and environmental protection, while smart living refers to the quality of life in different areas such as culture, health, safety, housing, tourism, etc. (Giffinger et al., 2007).

The City of Dubrovnik has developed a strategy of smart city called “The Smart City – Dubrovnik”. It consists of several key smart city projects: “Smart Parking” that ensures checking of the availability of parking spaces covered with sensors, using Android, iOS and web applications. Further, “Smart Sprinklers” includes the first public park in Dubrovnik, which incorporates the latest Internet of Things^s technology for smart irrigation. “Solar Bench” project enables charging of smaller electrical devices like smartphones and tablets, while “Dubrovnik Card” is an application that offers information about certain benefits on products and services within “Dubrovnik Card”, such as free entrance to museums and galleries, bus rides, discounts at restaurants and so on. There is also a project called “Dubrovnik Eye” that enables citizens to report on communal issues that they spot in the city by using web and mobile applications (City of Dubrovnik Development Agency, 2015). The City of Zagreb has no smart city strategy but only “The Framework Strategy of the Smart City” that focuses on the following strategic areas (The City of Zagreb, 2018): Digital infrastructure, efficient, transparent and smart city administration, smart energy management and communal services, education, economy, and sustainable urban mobility. Regarding other cities in Croatia, there are about thirty cities that have developed some smart projects: Gospić, Otočac, Karlobag, Senj, Osijek, Slavonski Brod, Koprivnica and Karlovac have “Traffic and Urban Mobility and Public Bicycles” project. Zagreb offers the possibility of car sharing or driving, while the town of Krk and the municipalities on the island of Krk are managing island services, such as parking lot monitoring system, maintenance records of waste, electric car chargers, and LED lighting. City of Zagreb and town of Osijek have solutions for monitoring public transportation, while the City of Zagreb and towns of Osijek, Rijeka, Velika Gorica, Koprivnica, and Pula offer an overview of traffic and tourism trends. There are energy renewal and energy efficiency solutions in the towns of Sisak and Labin, and solutions to support entrepreneurial climate with the proven transparent operation of city administration and openness to entrepreneurs in Pula and Ivanec. The town of Umag has the project of introducing sustainable and ecological communal infrastructure that includes reduction of exhaust gases, use of renewable energy sources, remediation of old waste dumps, and achieving modern sorting ecological awareness of citizens (Jurlina Alibegović & Šagovac, 2015).

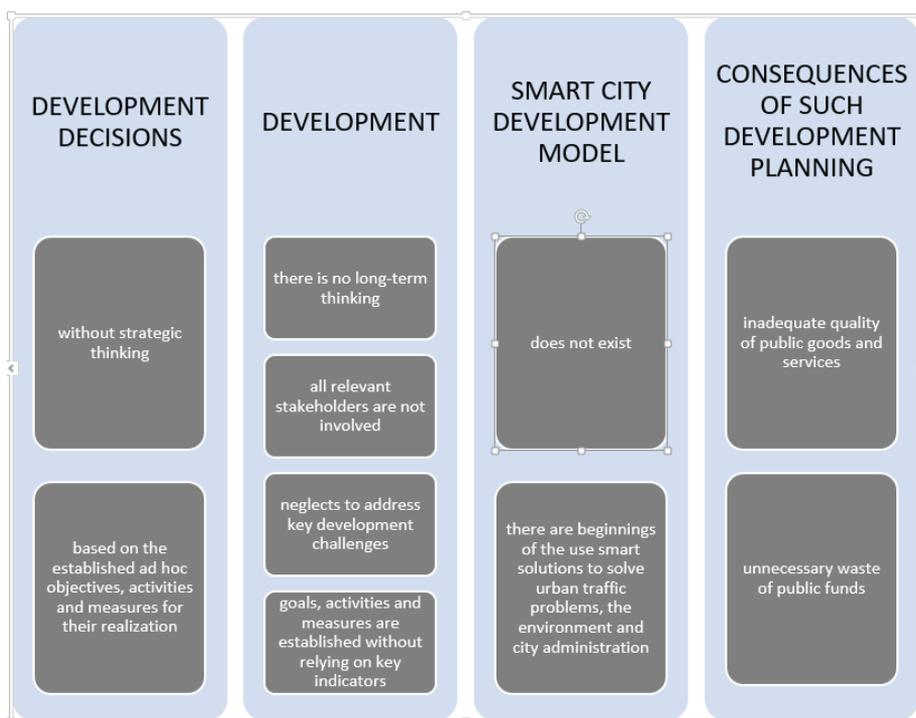


Figure 3: Current Obstacles in Implementation of Smart Cities in Croatia

Source: authors, based on Jurlina Alibegović & Šagovac, (2015)

According to Jurlina Alibegović and Šagovac (2015), there are several obstacles to the smart city development in Croatia, as shown in the above figure (Figure 3). The conclusion is that the main obstacle lies in the absence of proper analysis of the current situation and in making decisions that are not based on strategic long-term thinking. In addition, there is an urgent need to incorporate smart solutions at all municipal levels in Croatian cities.

Conclusion

The world trends, as well as trends in Croatia, show that the number of inhabitants living in cities is constantly growing. It is expected that 70% of the total world and 80% of total European population will live in cities by 2050. This situation places significant challenges to the cities' management institutions. The obvious solution for achieving maximum living standards and quality of life of the city population in the form of implementing smart city model proves to be a necessity. At the European Union level, there are several policies and initiatives in place that are promoting the

development of smart cities, and Croatia, as a member of the European Union, is obliged to follow all these policies and initiatives. According to the European Commission, smart city should be a place where traditional networks and services are made more efficient by the use of digital and telecommunication technologies. For the benefit of its inhabitants and businesses, a better resource use and less emissions, smarter urban transport networks, upgraded water supply and waste disposal facilities, more efficient ways to light and heat buildings, more interactive and responsive city administration, and safer public spaces, while meeting the needs of an ageing population are needed. The paper provides the framework for understanding the concept of smart cities through an overview of scientific literature, examples of good practice, and a detailed analysis of the state and degree of development of smart cities in the Republic of Croatia, focusing on key dimensions of smart city development. By using mixed method that involves collection, analysis, and integration of quantitative and qualitative research, it is proven that investing in key dimensions of a smart city: Population, technology, and institutions, generates revenue growth, economic development, and better quality of life for urban population. It is shown that the situation in Croatia, regarding the implementation of smart cities, is not satisfactory, since Dubrovnik is the only town that has developed smart city strategy, and the City of Zagreb is still in the process of developing the framework for smart city. As the main obstacles in Croatia were noticed the absence of proper analysis of the current situation and making decisions that are not based on strategic long-term thinking.

The paper provides a framework for understanding the concept of a smart city pointing out the advantages of such management mode. The key dimension to be investing in is to boost the economic development and quality of life of the dominant, city population and emphasize the urgency of incorporating smart solutions at all municipal levels in Croatian cities.

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